

FERMENTATION DESIGN, INC.

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Poughkeepsie, N.Y. 12603

CATALOG



For your fermentation work, whether it be in research, teaching, or pilot production, the enclosed literature describes for you FD's new line of fermentation equipment, the best on the market.

Check over the features, specifications, and prices of the FD line, and we hope you'll agree.

You want to carry out your fermentation work with a minimum of time wasted on setting up and operating. With high standards of performance and capability, FD equipment will help you reach that goal. So, specify FD items on your forthcoming purchases.

For prompt service, either contact us directly, or call your regular Scientific Products representative, or fill in and return the enclosed business reply card.

One more point. This new literature describes standard off-the-shelf items. FD also possesses the engineering and manufacturing talent and capability to create tailor-made systems for special needs.

For example, see the photos of typical pilot plant equipment designed and manufactured by FD expressly for customers' special needs. FD is also equipped to handle complete turn-key pilot and production scale projects including feed, fermentation, harvesting, and extraction.

Let us help you with your special problems; we're tops in solving problems of fermentation instrumentation and equipment.

Sincerely yours,

Oswald Stewart
Sales Manager

Enclosures: 7 FD sheets
1 SP folder
1 reply card

Now . . . A VERSATILE LINE OF BENCH TYPE FERMENTORS

designed by
FERMENTATION DESIGN

and featuring . . .

- Stepless wide-range agitator speed control
- Temperature control to $\pm 0.5^{\circ}\text{C}$
- Versatile air system and sterilizing filter
- Easily scaled up to pilot plant and production sized equipment

F D biO-Kulture Assemblies are flexible bench-scale modules for biological processes. They can be used in the study of a wide variety of microbial and tissue culture processes, as well as in biological waste treatment studies.

Assemblies are portable and can be placed and operated quietly on existing laboratory bench tops. They eliminate need for valuable laboratory floor space and costly special laboratory construction or rearrangement. Assemblies can be placed side by side to provide for utmost versatility in minimum of space. In such an installation, all units are completely independent of one another; each assembly has its own panel for agitation, aeration, foam and temperature control.

Outstanding features of F D Bench-Scale biO-Kulture Assemblies include:

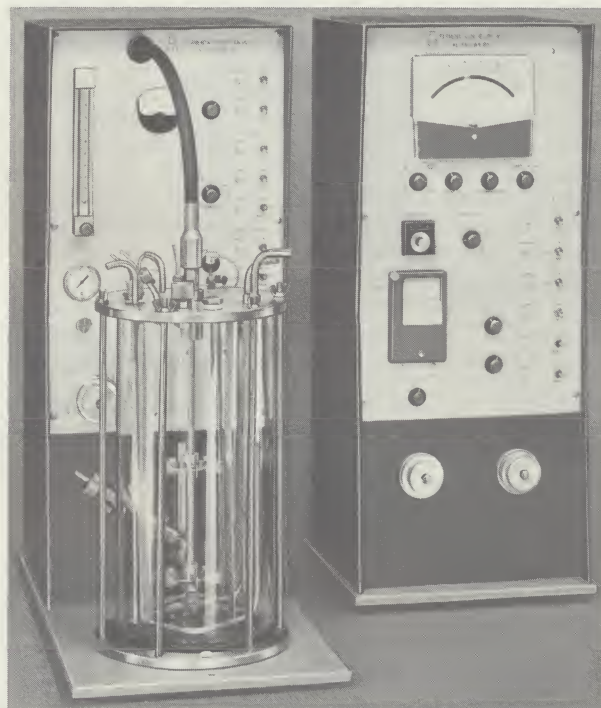
STEPLESS WIDE-RANGE AGITATOR SPEED CONTROL—

Every Fermentor Assembly is equipped with turbine impellers in the fermenting vessel and powered by an individual motor controlled by a solid state electronic speed controller. This type speed control permits simple and accurate selection of stepless control of agitation.

The triple-seal bearing assembly in the fermentor is completely autoclavable, provides a maximum of protection from contamination, and requires a minimum of maintenance.

A tachometer mounted on front panel shows agitation speed at all times. The fermentor is provided with 2 turbine impellers. The torque developed by multiple impeller arrangements prevents variation from speed setting of controller even in the thickest of biological submerged cultures. High horsepower is responsible for high aeration and agitation rates in thick cultures.

Particular attention is paid to the geometry of the vessels and the relationships between speed, power and impeller diameter. This design feature is of great value in scaling up to pilot plant and production equipment.



TEMPERATURE CONTROL TO $\pm 0.5^{\circ}\text{C}$ —Fermentor temperature is controlled by continuously circulating water through a heat exchanger within the vessel. The heat exchanger inlet and outlet tubes are welded directly into vessel head. Water is heated, as required to maintain the desired culture temperature by an in-line submerged electric cartridge heater located in control cabinet. Cooling is accomplished by circulating tap water through the system.

Recirculation of tempered water provides temperature stability and a fine degree of control. Temperature of the culture can be maintained effectively within 0.5°C to as high as 70°C and as low as 5°C above the temperature of the cooling water available.

Control is maintained by means of a transistorized temperature controller employing a thermistor sensing element. Transistorized control circuits offer advantages over instruments of this type using vacuum tubes or millivolt meter movements because aging will not affect components. This results in a higher degree of stability and longer operation life. Each fermentor is equipped with a thermometer well permanently welded into the head.

VARIABLE SENSITIVITY FOAM CONTROL—The foam control system, optional on the fermentors, consists of three major components: a foam probe, a foam controller, and an anti-foam agent pump.

The probe is located in the vessel head and is adjustable to accommodate various heights of culture media.

Foam Controller is placed on main control panel. The sensitivity controller built into foam control circuit allows detection of the slightest froth, or it can be adjusted to permit the accumulation of light froths and prevent detection until foam consistency becomes heavy.

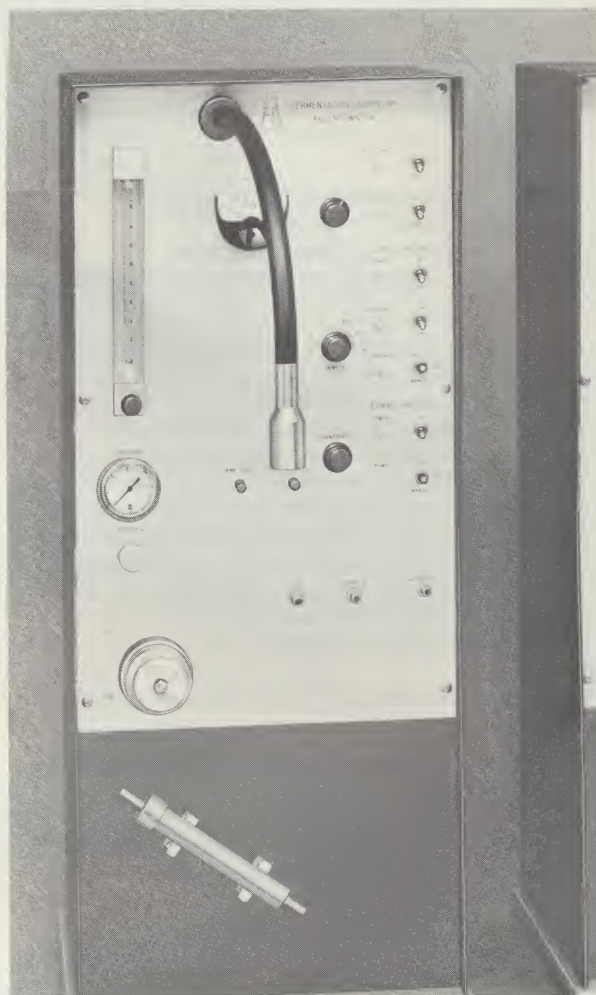
The anti-foam pump, located on control panel, is a peristaltic pump that pumps the anti-foam agent through a $\frac{1}{8}$ " I.D. x $\frac{1}{4}$ " O.D. tube and never contacts any portion of the pump itself. Standard pump capacity is 60 ml per hour.

VERSATILE AIR SYSTEM—Features precision air supply pressure indicator and regulator valve mounted on main control panel. A panel mounted flowmeter with an integral needle control valve is also provided. Novel optional feature provides for a second flowmeter with its needle control valve that allows aeration studies employing pure oxygen, various oxygen-enriched air ratios, hydrocarbon or carbon dioxide enrichment, or complete nitrogen blanketing of anaerobic systems. Also, any other gas may be introduced to the culture vessel through the auxiliary flowmeter. This is another F D exclusive design.

REMOVABLE STERILIZING FILTER—Each assembly is supplied with a stainless steel air filter with a holding cradle mounted under the main control panel. The filter can be removed for sterilization with the culture vessel. It is pre-packed with a specially blown fiberglass for effective air sterilization. This packing will give positive filtration of all bacteria and other organisms 0.5 microns or larger in size. A screw cap on filter permits repacking when required. Outlets on each end are connected easily by rubber tubing to the air supply on main control panel and to the air delivery tube on culture vessel.

DURABLE MAIN CONTROL PANEL AND STURDY VESSEL SUPPORT PLATE—Air regulator, pressure indicator, flowmeters, temperature controller, tachometer and foam controller are mounted on a main control panel of anodized aluminum. Control functions are handsomely lettered for permanent, easy identification.

Panel is attached to a rugged steel cabinet firmly mounted on a sturdy vessel support plate. The base plate of the culture vessel rests on support plate and is secured by 2 bolts to give the assembly rigid support during operation. Vessel base plate provides protection from breakage.



Cover on back of cabinet can be removed for easy access to all parts for servicing; enclosure contains piping and electrical connections. Assembly is designed for ease of operation and maintenance.

FERMENTATION DESIGN VARI-LIGHT—A basic, 3-section light bank is available as an accessory for photosynthetic fermentations. The sections are separable and can be spaced around the fermentor as desired. Light intensity is readily changed in each section and additional sections are easily added to give needed intensity with uniform light distribution.

scientific products

All vessel head assemblies provide for complete instrumentation and operation in batch or continuous culture. Ports and Openings:

Ports

Inoculation
Spurge air
Air exhaust
Liquid addition
Harvest and sample

Openings

pH electrode
Acid addition
Base addition
Anti-foam probe
Anti-foam addition
Dissolved oxygen electrode

Overall dimensions of all fermentors: 15"w x 30"d x 36"h.

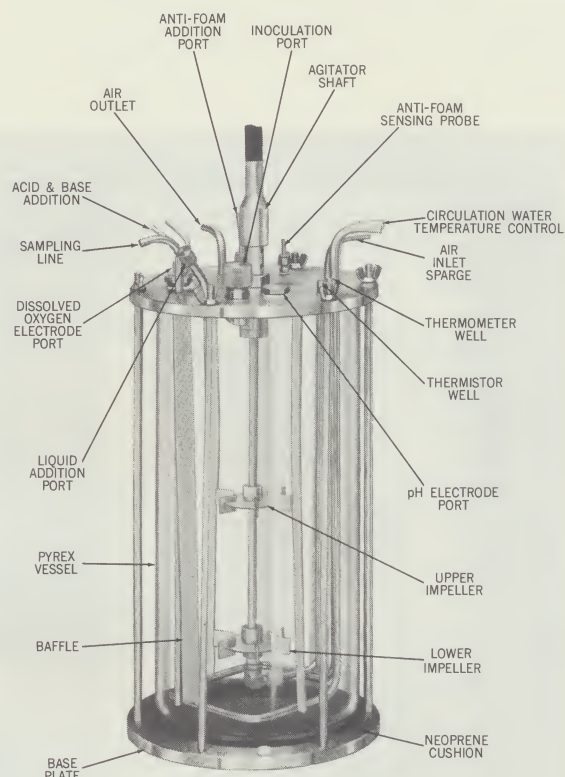
SERVICE REQUIREMENTS

Electrical.....115 volts, 60 cycles, single phase,
15 amps. max.

Water.....City water or equivalent
($\frac{3}{8}$ -18 NPTF connection)

Drain.....Standard non-pressurized waste line
($\frac{3}{8}$ -18 NPTF connection)

Air.....15 psi minimum dry or laboratory air
($\frac{1}{4}$ -18 NPTF connection)



Order No. Fermentor	Model No.	Capacity Liters	Foam Control	Agitator RPM	H.P.	Flowmeter Range, l/m	Each
F1120-1	SA51	5	No	0 to 800	$\frac{1}{8}$	0 to 8.6	\$1725.00
F1120-5	SA5F1	5	Yes	0 to 800	$\frac{1}{8}$	0 to 8.6	2075.00
F1122-1	SA751	7.5	No	0 to 800	$\frac{1}{8}$	0 to 8.6	1750.00
F1122-5	SA75F1	7.5	Yes	0 to 800	$\frac{1}{8}$	0 to 8.6	2100.00
F1125-1	SA141	14	No	0 to 800	$\frac{1}{4}$	0 to 16	1850.00
F1125-5	SA14F1	14	Yes	0 to 800	$\frac{1}{4}$	0 to 16	2200.00
F1130-1	SA301	30	No	0 to 500	$\frac{1}{4}$	0 to 44	2200.00
F1130-5	SA30F1	30	Yes	0 to 500	$\frac{1}{4}$	0 to 44	2550.00

The anti-foam pump and air flowmeter supplied with the fermentors are adequate for most applications. However pumps and flowmeters can be supplied with different ranges for specific applications. Contact your S/P representative or regional office for further information.

ACCESSORIES AND REPLACEMENT PARTS

F1170

FILTER, Air Filter—Replacement for all fermentors.

Order **F1170—Filter**Each **\$30.00**

FLOWMETER, Auxiliary Gas—Used for the introduction of other gases to culture vessel, and can be supplied on all fermentors. Auxiliary flowmeters must be factory installed with delivery approximately 90 days.

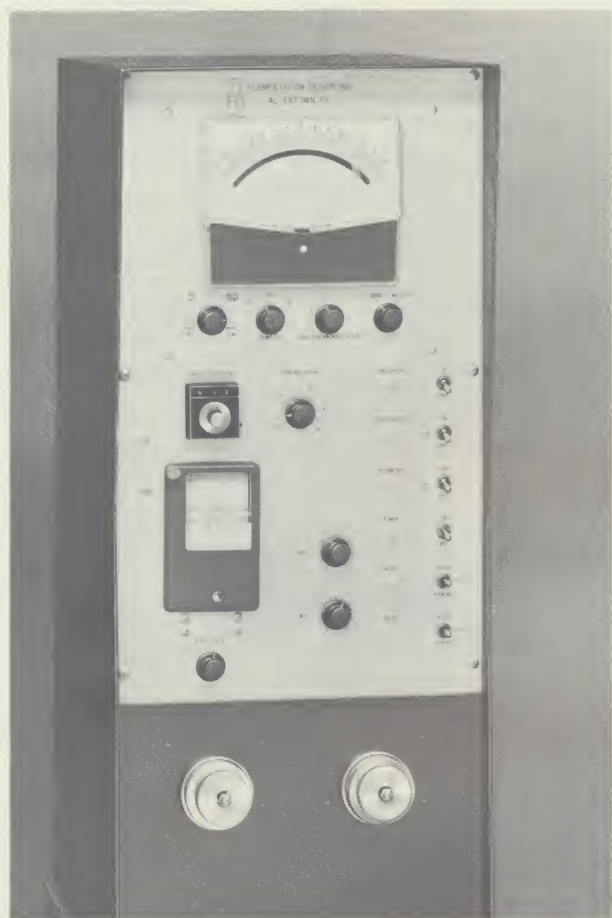
Order Flowmeter

Order	Range liter/minute	Price
F1172-1	0 to 2.5	\$80.00
F1172-2	0 to 8.6	75.00
F1172-3	0 to 16	75.00

F1174

LIGHT, Manifold, Photosynthetic—Separable 3-section light bank for F1122-1, -5 and F1125-1, -5 Fermentors.

Order **F1174—Light**Each **\$350.00**



pH CONTROL UNITS

- Simultaneous pH control in either direction
- Exclusive Dual-Dial easy to select set-point and control span

F D pH Control Units contain all of the essential components mounted on a single panel. The basic elements are a Leeds and Northrup Model 7401 pH indicator and a unique and revolutionary Dual-Dial pH controller. To operate, simply select the set-point on a direct digital read-out dial, and adjust the high and low limits for the desired control span. When the pH varies and reaches either of the limits, an output relay actuates acid or base addition until the set-point is reached again. The adjustable control span can be set to meet the degree of control required by the process, from 0.05 to 0.50 pH units.

A strip chart recorder continuously records the entire process when desired. A timer with adjustable periods for adding and mixing acid or base is an integral part of the system. The timer allows adequate mixing time between additions of acid or base, thus preventing overshoot and undesirable cycling in control. For use in small scale laboratory applications, peristaltic pumping heads can be mounted on the panel with their motor drives enclosed behind the panel. Standard pump capacity is 60 ml per hour. Peristaltic pump is included in F1153 pH Control Unit.

SPECIFICATIONS

LEEDS AND NORTHRUP pH INDICATOR

0 to 14 pH range in 0.1 pH smallest divisions
 ± 0.07 pH unit accuracy
 7" scale length
 Manual temperature compensation

STRIP CHART RECORDER

2% Full Scale accuracy
 2-5/16 Useable chart width
 1-inch per hour chart speed
 (unless requested otherwise)

DUAL RANGE: 30 divisions equal 4-10 pH

(0.2 pH smallest division)

30 divisions equal 5.5-8.5 pH

(0.1 pH smallest division)

DUAL-DIAL pH CONTROLLER

0-10 pH range in 0.01 unit intervals
 ± 0.01 pH unit accuracy
 0.05-0.50 pH unit control span
 $\pm 5\%$ accuracy of span setting

DUAL PERIOD TIMER

0 to 30 sec. adjustable add period
 0 to 30 sec. adjustable mix period

F1150

pH CONTROL UNIT, F D Model No. PH-RT—Complete with indicator, controller, timer and recorder.

Order **F1150**—pH Control Unit. Each **\$1595.00**

F1153

pH CONTROL UNIT, F D Model No. PH-RTP—Complete with indicator, controller, timer and recorder with acid and base peristaltic pumps.

Order **F1153**—pH Control Unit. Each **\$1895.00**

The acid and base peristaltic pumps supplied with F1153 pH Unit are adequate for most applications. However, pumps and flowmeters can be supplied with different ranges for specific applications. Contact your S/P representative or regional office for further information.



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726 NO. GRAHAM STREET

ALLENTOWN, PA. 18103

ATTN: Oswald Stewart



Date _____

Dear Mr. Stewart;

Thank you for the new product literature. I have the following additional questions:

NAME _____

TITLE _____

ORGANIZATION _____

STREET _____

CITY _____ STATE _____ ZIP _____

☐ Please have a representative contact me.



BENCH-TOP MAGNETIC DRIVE FERMENTOR

Here's unprecedented agitator power in a magnetic drive fermentor. Fermentation Design's complete new Magnetic Agitation series delivers full-scale aeration-agitation power to the culture, and eliminates shaft seal contamination.

MAGNETIC DRIVE

With new multipole ceramic magnet technology, a full 1/8 HP is transmitted in the 14-liter size fermentor, equivalent to 4 HP per 100 gallons.

IDEAL CHEMOSTAT

Designed especially for use as a Chemostat or in continuous culture applications requiring long-term contamination-free operation. Headplate contains ample ports and openings for full instrumentation. The FD Constant Level Metering Module is particularly suitable for this type of work. See Descriptive Sheet 501.

STANDARD GEOMETRY

Full size, 6-bladed turbine impellers are supplied for the entire size range of FD magnetic drive fermentors: 2, 5, 7-1/2, and 14 liters. The impellers are based upon the 4:5:20 ratio which combines maximum oxygen transfer with maximum bulk mixing. Standard geometry of impellers and vessels also assists in scaling up results.

BETTER USE OF HEAD PLATE

By saving space occupied by a shaft seal, the FD stainless steel head plate contains more ports and openings for added convenience and future utility.

NO AGITATION SEAL LEAKAGE OR CONTAMINATION PROBLEMS

FD's magnetic coupling design has eliminated the traditional source of contamination, without sacrifice of agitation capability.

SAVES BENCH SPACE

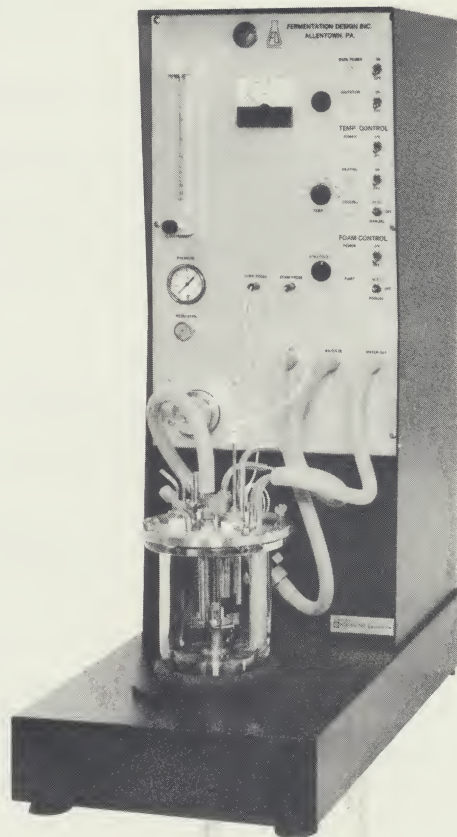
Compact design requires only 15" of bench space, yet is convenient and easy to use.

GENERAL FEATURES

A self-lubricating Teflon[®] bottom bearing between the glass vessel and magnetic agitator insures long trouble-free service life.

Autoclavable vessel with headplate and tubing can be quickly removed for sterilizing.

Modular engineering of FD fermentors permits the convenient addition of accessory analytical and control instrumentation such as pH, dissolved oxygen, continuous culture, redox, and antifoam. Other modular controls can be designed for special needs.



GENERAL DESCRIPTION

VARIABLE-SENSITIVITY FOAM CONTROL (OPTIONAL)

Foam probe in the headplate is adjustable to desired height above culture media.

Foam controller on cabinet panel allows sensitive detection of the slightest froth, or it can be set to delay detection until foam becomes heavy.

Peristaltic pump on cabinet panel pumps anti-foam agent through 1/8" ID x 1/4" OD tubing at rates to 30 ml per hour.

VERSATILE AIR SYSTEM

Precision air supply pressure gauge and regulator valve are mounted on cabinet panel.

Flowmeter on cabinet panel contains needle control valve.

Optional second flowmeter and needle control valve permits aeration studies of additional gases or gas mixture.

SUPPLY AIR HYPER-FILTER

Stainless steel air filter is clipped below control panel on cabinet. Containing resin-bonded fiberglass packing, it filters organisms 0.5 microns or larger, and is readily detached for autoclaving with the culture vessel.

STEPLESS WIDE-RANGE SPEED CONTROL OF AGITATION

Speeds from 50 to 800 RPM are available from FD's solid-state stepless DC controller.

INSTANTLY REPEATABLE SPEED SETTINGS

Easy-to-read calibrated tachometer on cabinet panel permits the precise duplication of speed settings with one convenient knob setting.

PRECISE TEMPERATURE CONTROL

Vessel temperature is controlled by continuously recirculating water through a stainless steel heat exchanger. Heat source is an electric cartridge heater. Cooling source is tap water or chilled water supply.

Culture temperature control is maintained by solid-state controller with thermistor sensing element. Temperature range is from 5°C above cooling water source to 70°C.

Accuracy: $\pm 1/2^\circ\text{C}$.

GENERAL SPECIFICATIONS

Overall dimensions 15" wide x 30" deep x 39" high

SERVICE REQUIREMENTS:

Electrical 115 volts, 60 hertz, single phase,
15 amps maximum

Water Tap water or chilled water source
(3/8-18 NPTF connection)

Air 15 psi minimum dry or laboratory air
(1/4-18 NPTF connection)

Drain Standard non-pressurized waste line
(3/8-18 NPTF connection)

Unconditional 1-year warranty.

HEADPLATE PORTS

HEADPLATE OPENINGS
(Shipped Plugged)

Dry addition port with screw cap	Anti-foam probe, 1/8" NPTF
Sampling and harvest	Anti-foam addition, 1/8" NPTF
Sparge air	Acid addition, 1/8" NPTF
Exhaust air	Base addition, 1/8" NPTF
Liquid addition	pH electrode, 3/4" NPTF
Thermometer well	Dissolved oxygen, 3/4" NPTF
Thermistor well	Two spare openings, 3/4" NPTF

PRICES

Model	Capacity, Liters	Foam Control Furnished	Agitator RPM	HP	Flowmeter Range, LPM	Price
MA0201	2	No	0-800	1/15	0-2.5	\$1785.00
MA02F1	2	Yes	0-800	1/15	0-2.5	2135.00
MA0501	5	No	0-800	1/15	0-8.6	1810.00
MA05F1	5	Yes	0-800	1/15	0-8.6	2160.00
MA0701	7½	No	0-800	1/15	0-8.6	1840.00
MA07F1	7½	Yes	0-800	1/15	0-8.6	2190.00
MA1401	14	No	0-800	1/8	0-16	1945.00
MA14F1	14	Yes	0-800	1/8	0-16	2295.00

ACCESSORIES

Optional gas flowmeter and needle control valve:	0 to 2.5 LPM	\$ 80.00
	0 to 8.6 LPM	75.00
	0 to 16 LPM	75.00
Exhaust Air Hyper-Filter		\$ 30.00
Photosynthetic Light Manifold (7½ and 14-liter Models only)		\$350.00

Prices and specifications subject to change without notice.



pH CONTROL MODULE

In a single compact cabinet, Fermentation Design now offers accurate pH control for one up to six fermentors, achieving outstanding economy, flexibility, and utility. Especially tailored for a wide range of fermentation requirements, FD's pH Control Module contains all the basic instrumentation required for precise analyzing, indicating, recording, and control of pH.

FLEXIBILITY

The basic controller indicates, records, and controls the timed addition of acid or base into a single fermentor.

The installation — now or later — of FD's 6-station stepper assembly will control pH on as many as six fermentors. All this is in one standard cabinet, and priced at a fraction of the cost of conventional separate instrumentation for each fermentor.

COMPACT DESIGN

Entire control module (for controlling one fermentor or up to six fermentors) occupies only 15" of bench space.

PRINCIPAL COMPONENTS

Reliable L & N 7401 pH meter with 7" dial.

Dual range strip recorder, 4 to 10 pH units and expanded scale, 5.5 to 8.5 units.

Dual dial electronic controller with digital set point (0 to 10 pH units) plus variable span adjustment. Controls either or both acid and base additions.

Dual timers for independent control of addition and delay times.

EASY READABILITY; EASY OPERATION

Eye-level arrangement of dials and controls assures easy and accurate settings and readings.

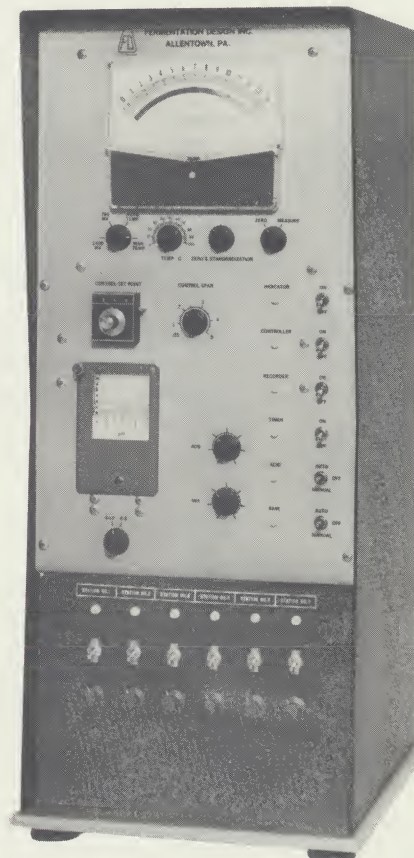
6-STATION STEPPER ASSEMBLY

Progressively applies all of the functions of the FD pH Control Module (indicate, record, and control) for up to six fermentors, at one-minute intervals.

Station-seeking; serves only active stations.

Each station electrode may be individually standardized.

Individual set points may be established for each station by standardization adjustment.



GENERAL SPECIFICATIONS and PRICES

Overall dimensions 15" wide x 15" deep x 36" high.
 AC power input 115 volts, 60 hertz, single phase.

Unconditional 1-year warranty.

Model PHRT pH Control Module, complete with indicator, controller, recorder, and timer	.Each	\$1595.00
Model PHRTP pH Control Module, complete with indicator, controller, recorder, timer, and two peristaltic pumps for acid and base additions	.Each	\$1895.00
Model PHRT6 pH Control Module, complete with indicator, controller, recorder, timer, and 6-station stepper assembly	.Each	\$2445.00
Model PC1 pump assembly, complete with one peristaltic pump (cabinet mounted), for acid or base addition. Rate: 30 ml per hour	.Each Assembly	\$175.00
Model PC2 pump assembly, complete with two peristaltic pumps (cabinet mounted), for acid and base additions. Rate: 30 ml per hour	.Each Assembly	\$325.00
Model PHS6 6-station Stepper Assembly only. Can be quickly installed by user into Model PHRT pH Control Module, thereby converting it into a Model PHRT6 Control Module	Each	\$850.00
Model PHS6C 6-station Stepper Assembly (cabinet mounted), for easy electrical connection into any PF pH Control Module	Each	\$900.00
Model F1155-1 pH Electrode Kit, complete with Ingold autoclavable pH electrode with holder, 6 feet of cable, connector, and jack. Immersion length: 300 mm	Each	\$225.00

Components and systems for special pH control requirements can be tailored to specific needs. Write for details and prices, stating your control parameters. Also available is a complete range of electrodes, holders, and fittings to suit all types and sizes of fermentor vessels.

Prices and specifications subject to change without notice.



DISSOLVED OXYGEN CONTROL MODULE

Fermentation Design's Dissolved Oxygen Controller with steam sterilizable electrode precisely analyzes and controls oxygen concentration with rapid response and stable output. It is an effective new tool for fermentation technology in studies of aeration, oxygen uptake, and scale up. Versatile, the controller can alter sparge and agitation rates separately or simultaneously, and can control gas additions.

STEAM STERILIZABLE ELECTRODE

Polarographic membrane gold-silver electrode is warranted for a minimum of 30 sterilizations.

Electrode is steam sterilizable without removing from the fermentor headplate, thereby eliminating a possible source of contamination.

COMPACT DESIGN

Entire control module occupies only 15" of bench space.

VERSATILITY

DO Control Module contains all the basic instrumentation required for accurate dissolved oxygen analysis and control in fermentation work.

It precisely analyzes oxygen concentration, with drift of less than 1% per day.

The output of the control module can be used to maintain the set point concentration level (1) by changing air sparge rate, (2) by changing agitation rate, (3) by changing sparge and agitation rates simultaneously, and (4) by adding oxygen and nitrogen to the sparge line.

RAPID RESPONSE

Sophisticated design of electrode and electronic components achieves 90% of final DO value in as fast as 6 seconds.

Rapid response provides an effective means of determining oxygen uptake rate and is especially useful in scale up studies.

STABILIZED MEMBRANE

Electrode tip design assures a stable readout regardless of turbulence.

PRINCIPAL COMPONENTS

FD dissolved oxygen indicator with 5-1/2" meter, 0 to 100 scale, 50 divisions. Accuracy $\pm 1\%$.

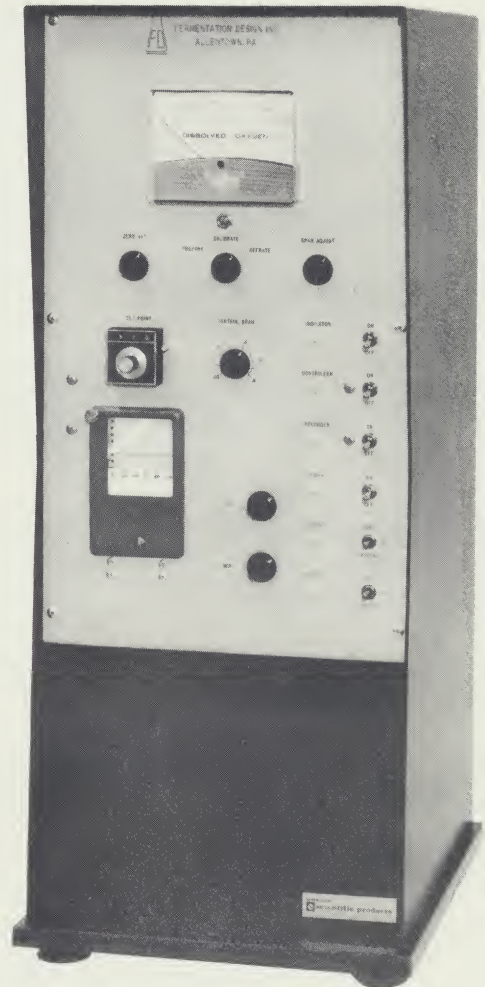
FD dual dial electronic controller with digital set point and adjustable control span.

Adjustable timers for variable control and delay times.

3" strip chart recorder with 50 division paper.

Electrical outlet receptacles for control functions.

Steam sterilizable polarographic electrode.



GENERAL SPECIFICATIONS and PRICES

Overall dimensions 15" wide x 15" deep x 36" high
AC power input 115 volts, 60 hertz, single phase

Unconditional 1-year warranty.

Model DORT DO Control Module, complete with indicator, controller, recorder, and timer Each \$1595.00

Model SG186 Steam Sterilizable DO Electrode, 18" length with 3/4" NPT headplate fitting,
8 feet of cable, and membrane replacement kit Each \$ 300.00

Electrode Warranty: The electrode is warranted to have a useful life (exclusive of membrane replacement) of at least one year or 30 sterilizations, whichever occurs first. Adjustments will be made on a pro rata basis.

Components and systems for special DO control requirements can be tailored to specific needs. Write for details and prices, stating your control parameters.

Other fermentation instrumentation modules are also available for analysis and control of pH, redox, continuous culture fermentations, and antifoam additions.

Prices and specifications subject to change without notice.



BENCH-TOP MAGNETIC DRIVE WATER BATH SHAKER

FD Water Bath Shakers offer quick interchangeability between rotary and reciprocating motion, giving unprecedented versatility at far less cost than for two shakers. Engineered with a powerful magnetic drive featuring multipole ceramic magnets, the stainless steel leak-proof water bath can be readily converted from one motion to the other by interchanging drive units. Snap-in platforms can be specified for a variety of flask and test tube sizes.



CONVERTIBLE MOTION

FD Water Bath Shaker can be purchased with either rotary or reciprocating motion. Either unit can be easily converted to the other motion with the purchase of the appropriate kit.

MAGNETIC DRIVE

Multipole ceramic magnetic drive from beneath requires no openings for drive shafts in the water bath. No leakage problems.

COMPACT DESIGN

Requires only 16" of bench space, yet its unique convertability provides the flexibility of two conventional shakers at a fraction of their cost.

ACCURATE TEMPERATURE CONTROL

Precise easy setting of control knob will control bath to $\pm 1/4^{\circ}\text{C}$ with a range from supply water temperature to 70°C . A second safety thermostat protects against over-temperature damage.

DYNAMIC BALANCING

Shaker will not creep or walk, even at high speed operation.

STEPLESS WIDE-RANGE SPEED CONTROL

Speeds from 25 to 400 circular orbits or 25 to 200 linear strokes per minute are instantly available from FD's solid-state stepless controller.

INSTANTLY REPEATABLE SPEED SETTINGS

Easy-to-read calibrated tachometer permits the precise duplication of speed settings with one convenient knob setting.

PRECISE LEVEL CONTROL

Bath water level can be set at the level best suited for the particular flask size.

SNAP-IN PLATFORMS

Easily interchanged platforms will accommodate a wide range of flask and test tube sizes. Platforms snap in or out with no nuts or bolts required.

WATER BATH SHAKER GENERAL SPECIFICATIONS and PRICES

Model OSW21	1/2" diameter circular orbit
Model RSW61	1-1/2" reciprocating stroke
Overall dimensions	16" wide x 27" long (front to back) x 14" high. (Height does not include flask necks extending above lip of water bath.)
Speed	40 to 400 circular orbits per minute, or 20 to 200 reciprocating strokes per minute.
Temperature Control	From supply water temperature to 70°C with $\pm 1/4^\circ\text{C}$ accuracy
Stainless steel water bath dimension	14" wide x 17-1/2" long x 6-1/2" deep

SERVICE REQUIREMENTS

Electrical	115 volts, 60 hertz, single phase, 10 amps max.
Water	Tap water or chilled water source. (1/2-14 NPTF connection)
Drain	Standard non-pressurized waste line (1/2-14 NPTF connection)

Unconditional 1-year warranty.

Model OSW21 Water Bath Shaker, magnetic drive, equipped for orbital motion.	Each	\$800.00
Model RSW61 Water Bath Shaker, magnetic drive, equipped for reciprocating motion.	Each	\$800.00
Model OSW1 Interchangeable Drive Unit, to convert water bath shaker from reciprocating to orbital motion.	Each	\$250.00
Model RSW1 Interchangeable Drive Unit, to convert water bath shaker from orbital to reciprocating motion.	Each	\$250.00

WATER BATH SHAKER PLATFORM AND RACK SPECIFICATIONS and PRICES

FOR FLASKS

Catalog No.	Erlenmeyer Flask Size, ml	Flasks per Platform	Number of Platforms per Bath	Price per Platform
B50	50	13	2	\$28.00
B125	125	8	2	27.00
B250	250	5	2	24.00
C500	500	8	1	51.00
C1000	1000	5	1	48.00
C2000	2000	3	1	43.00

FOR TEST TUBES

Catalog No.	Test Tube Size, mm	Test Tubes per Rack	Number of Racks per Bath	Price per Rack
BT13	13	60	4	\$18.00
BT20	20	29	4	18.00
BT25	25	18	4	18.00

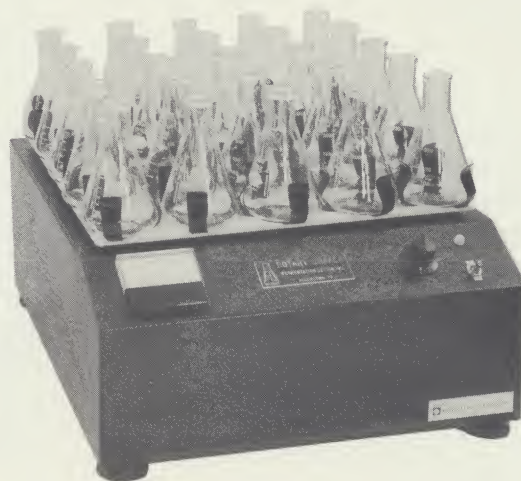
Prices and specifications subject to change without notice.



BENCH-TOP ROTARY SHAKER

FD Bench-top Rotary Shakers set new standards of usefulness and agitation along with vibration-free quiet operation. Dynamically balanced, they can operate at unprecedented speeds to produce high aeration-agitation shaking.

Truly bench-top in design and operation — no need to bolt them down or to be annoyed with noise — FD orbital shakers are stocked in two sizes. The single-platform Model OS31 (top illustration) accommodates one 16" x 16" platform for flasks or test tubes; the double-platform Model OS42 (bottom illustration) simultaneously shakes two platforms.



NO CREEP OR WALK

FD Shakers have been precision engineered for true dynamic balancing. FD Shakers do not creep or walk even at high speed operation.

HIGH SPEED HIGH AERATION RATE

Because of true dynamic balancing, FD Shakers possess higher speed capability than other shakers. They can operate up to 500 circular orbits per minute without vibration problems. Therefore shake-flask culture experiments can be carried out at higher aeration-agitation rates than heretofore possible.

STEPLESS WIDE-RANGE SPEED CONTROL

Speeds from 40 to 500 circular orbits per minute are instantly available from FD's solid-state stepless DC controller, for every shaking speed requirement.

INSTANTLY REPEATABLE SPEED SETTINGS

Easy-to-read calibrated tachometer permits settings to be precisely duplicated with one convenient knob setting.

READILY INTERCHANGEABLE PLATFORMS

All rotary shaker platforms are interchangeable between the two models to give maximum flexibility.

NO PLATFORM OVERHANG

No portion of the platform projects beyond the cabinet either at rest or during shaking. Flasks are protected from breakage because they cannot accidentally contact adjacent equipment.

LONG SERVICE LIFE

Precision machining and balancing assure quiet long-life performance of bearings and moving parts.

VERSATILE UTILITY

Drive unit runs cool; FD shakers are suitable for operation in incubator cabinets or rooms.

GENERAL FEATURES

Safety-engineered to eliminate possibility of pinching fingers between platform and base. Laboratory tools cannot drop accidentally into shaker base.

Baked-on finish of base and platforms is highly resistant to laboratory chemicals.

Platform layout gives optimum capacity for each size of flask.

Streamlined cabinet exterior is easily cleaned.

Unconditional 1-year warranty.

ROTARY SHAKER GENERAL SPECIFICATIONS and PRICES

	OS31 Single Platform	OS42 Double Platform
Height (Less platform)	8-3/4"	12-3/4"
Width	17-1/4"	34-1/2"
Depth	20-1/4"	20-1/2"
Weight (less platform)	66 lbs.	140 lbs.
Diameter of circular orbit	3/4"	1"
AC power input (115 volts, 60 hertz, single phase)	2 Amps	4 Amps
PRICE (less platform)	\$360.00	\$545.00

16" x 16" INTERCHANGEABLE PLATFORM SPECIFICATIONS and PRICES**FOR FLASKS**

Catalog No.	Erlenmeyer Flask Size, ml	Flasks per Platform	Unit Price
A50	50	64	\$78.00
A125	125	36	77.00
A250	250	25	64.00
A500	500	16	64.00
A1000	1000	8	52.00
A2000	2000	4	42.00

FOR TEST TUBES

Catalog No.	Test Tube Size, mm	Test Tubes per Platform	Unit Price
AT13	13	192	\$60.00
AT20	20	132	60.00
AT25	25	84	60.00

FOR GENERAL UTILITY

Catalog No.		Unit Price
AU	—with adjustable locking bars—	\$40.00

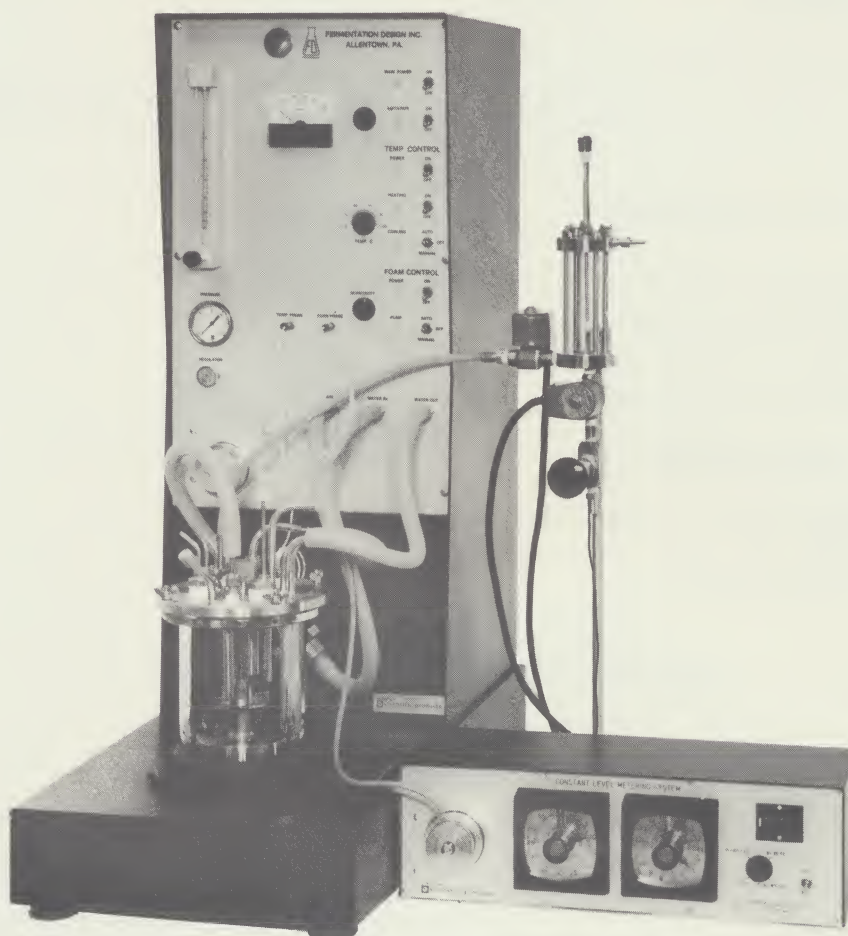
NOTE: FD Rotary Shaker OS31 requires one 16" x 16" platform.

FD Rotary Shaker OS42 requires two 16" x 16" platforms.

Prices and specifications subject to change without notice.



CONSTANT LEVEL METERING MODULE



FD's Constant Level Metering Module offers a fresh, new approach for use in continuous culture fermentations. Key features of the metering module are its extreme accuracy and simplicity in achieving metered feed additions and in maintaining a constant liquid level within the fermentor vessel.

This FD Metering Module is readily adaptable to any laboratory-size fermentor. The illustration shows a module operating with an FD 1-liter working capacity bench-top magnetic drive fermentor, an example of an ideal chemostat. (For details and prices of magnetic drive fermentors, see Descriptive Sheet 101.)

OPERATION

The FD Constant Level Metering Module consists of an electronic control cabinet, a metering chamber with level probe and flow valves, a feed nozzle with 3/4" NPT headplate connection, a harvesting suction tube with 1/8" NPT headplate connection, a peristaltic harvest pump, and polyurethane tubing. Feed reservoir and harvest vessel are furnished by user.

The chamber can be precisely set to meter from 2 to 25 ml per cycle. The cycle timer is variable from 48 to 240 cycles per hour, offering a wide range of feed rates from 96 to 6000 ml per hour.

The harvest pump harvests continuously and draws from an adjustable height, shielded harvest port. The height of the port determines the working volume of the vessel. The shield masks out surface material so that representative culture is harvested. The metered feed rate determines the harvest rate, and no balancing is required.



100-liter working volume fermentor with constant level metering system for continuous culture.